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ABSTRACT

This paper reviews the history and current state of research and development on microteaching and technical skills training, particularly as these are related to the Stanford University program. Background sections describe the historical development of the technical skills approach as a preservice teacher training program and its interrelationship with microteaching and videotape technology. Techniques of modeling (e.g., use of short videotape recordings of a master teacher performing a lesson to illustrate uses of a specific skill) are discussed. A previously unpublished study by the author, in which methods for acquiring the skill of higher order questioning were investigated, is described in detail. Several other studies illustrating the definition of skills in behavioral terms are reviewed, and the methodology used in the investigation of skill acquisition is described; specifically discussed are the skills of higher-order questioning, reinforcement, probing, stimulus variation, silence and nonverbal communication, and control of small groups. Related research in technical skill development is presented including discussions of inservice adaptations of the approach (e.g., minicourses) and extension to other areas (e.g., microcounseling). The final section on research needs contains some critical analysis of current research and summary of important questions requiring investigation in subsequent studies. (Author/JS)

STANFORD CENTER
FOR RESEARCH AND DEVELOPMENT
IN TEACHING

Technical Report No. 8

MICROTEACHING AND THE TECHNICAL SKILLS APPROACH TO TEACHER TRAINING

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A large debt is owed to F. J. McDonald, whose conception of technical skills training guided the research. The codirector of the early studies, Dwight W. Allen, provided important and developmental resources. R. N. Bush and the entire Stanford Secondary Teacher Education Program, staff and interns, aided in the growth of these ideas. The support of the Stanford Center for Research and Development in Teaching has been the major factor in the continuing evolution of the skills approach. The author wishes to thank the present coordinator of the Center's research in the skills area, Richard E. Snow, for his advice and editorial assistance. The author, however, is responsible for the approach to the topic and the integration of the information presented.

Abstract

This review summarizes a portion of the research concerned with developing a technical skills approach to teaching. It describes the historical development of the approach as a pre-service teacher training program and its interrelationship with microteaching and videotape technology. Several studies illustrating the definition of skills in behavioral terms are reviewed and the methodology used in the investigation of skill acquisition is described. Specifically discussed are the skills of higher-order questioning, reinforcement, probing, stimulus variation, silence and nonverbal communication, and control of small groups.

Related research in technical skill development is presented, including discussions of in-service adaptations of the approach and the extension of these techniques to other areas of education. Also included is a critical analysis of the research, providing a summary of some important questions to be investigated in subsequent studies of the technical skills approach to teacher training.

Because of the generally favorable results obtained by training teachers in the manner described here, this report should be of interest to institutions responsible for teacher preparation, to school administrators responsible for ongoing professional development in their districts, and to those interested in conducting research in teaching and teacher training.

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MICROTEACHING AND THE TECHNICAL SKILLS APPROACH TO TEACHER TRAINING

David C. Berliner[1]

The microteaching-technical skills approach to teacher training represents a major departure from tradition. The basic ideas originated with the work of F. J. McDonald, D. W. Allen, R. N. Bush, and others in the Stanford Teacher Education Program and the Stanford Center for Research and Development in Teaching. The program as it developed was given a strong impetus through recognition of the unique capabilities of television. The use of portable videotape recording equipment together with a new approach for defining teaching skills permitted a new form of practice for acquiring the skills of teaching. Since its initial development, the program has been implemented and elaborated by other individuals and groups concerned with teacher education.

The purpose of this paper is to review the history and current state of research and development on microteaching and technical skills training as these are related to the Stanford University program. Some suggestions for future work in this area will also be discussed.

Background

Traditional training programs for teachers require the novice to observe a "master" teacher in the regular classroom. These observations sometimes extend over long periods of time. At Stanford, where an intern teacher training program was being developed by an interdisciplinary team in the School of Education, such training was judged inadequate because: (a) it placed the novice teacher in a situation where both "good" and "bad" teaching behavior occurred; (b) the novice had to decide for

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himself, without an experienced supervisor close by, what teaching behaviors should be emulated. Sometimes poor teaching habits were learned, and sometimes the significance of certain exemplary behaviors was missed; (c) there was little opportunity for immediate practice of those teaching behaviors deemed important; (d) observation sessions were often time consuming, hard to schedule, occasionally boring, and frequently expensive for the novice who had to view classes in a cooperating school far from campus.

The first practical portable video equipment became available in 1963. The potential of this advance was recognized and the intern teacher training program at Stanford made adjustments to capitalize on the technology. Initially, it appeared that those aspects of the observational experience that were important to teacher training could be simplified and enhanced by recording on videotape the classroom behavior best illustrating them. The presentation of such recordings by supervisory personnel to large groups of interns on campus seemed to remove most of the earlier criticisms of traditional observational training for teachers. Though these possibilities provided distinct advantages, an even greater value was realized during exploratory work with the video equipment: the potential for detailed feedback of practice in teaching. The technique developed to capitalize on these capabilities was called microteaching. It was first employed as a diagnostic and training tool for the Stanford intern program in the summer of 1963.

Microteaching

In the microteaching technique, a teacher presents a brief well-planned lesson, usually five to ten minutes in duration, to a small group of students. The situation is essentially a scaled-down classroom within which real teaching takes place. It is not a simulated classroom, but merely a classroom with fewer pupils, usually four or five, and requires lessons of shorter duration than usual. This scaling down reduces to manageable proportions the otherwise confusing number and complexity of stimuli usually faced by the novice teacher

in the regular classroom. Moreover, laboratory conditions for the experimental study of classroom learning can be achieved with either novice or experienced teachers. The recording of each microteaching performance with unobtrusive video equipment provides a record from which the teacher can observe his own performance immediately following the lesson. A supervisor is available to review each performance, repeatedly if necessary, in slow motion or stopped if desired at some crucial point. Due to the objective video record, a concrete basis for the critique can be shared in detail by the supervisor and intern. The video record of the lesson provides a common starting point for discourse between supervisor and teacher, which seems also to lead to a reduction in anxiety on the part of the teacher trainee.

The initial uses of microteaching techniques with the Stanford intern teachers were directed toward improvement in such general teaching characteristics as clarity of presentation, pacing of the lesson, and beginning and ending a lesson. Such attributes were measured by the Stanford Teacher Competence Appraisal Guide, a rating form completed by both the intern supervisors and the students of a microteaching session. The Guide consists of 13 items, each with a seven-point, forced-choice scale. Adequate reliability over items and a moderate correlation with student achievement has been demonstrated in one study of the guide (Allen & Fortune, 1965). Significant differences between initial diagnostic video recording and a final video recording were found for nine of the 12 scales used in another study (Fortune, Cooper, & Allen, 1967). Among the intervening experiences between the pre- and post-recording sessions was a six-week microteaching clinic where particular emphasis was placed on each of the global characteristics measured in the Guide. The microteaching technique which seemed to be effective consisted of an initial teaching session, a playback and discussion of that session with a supervisor, and a second teaching of the same lesson with a new group of students.

During this period, problems in defining teaching behaviors became apparent. Different supervisors interpreted teacher characteristics in

slightly different ways. The rating of teaching performances was difficult because it was imposed upon impressions about classes of behavior, rather than on the actual behaviors themselves. More importantly, while the desired teaching behaviors could be described verbally and discussed by supervisors and interns, the behaviors were not themselves easily demonstrated. The video technology in the training process was not being used optimally in its unique function, that of preserving exemplary teaching behaviors for demonstration. This problem was resolved with the advent of the technical skills approach to teacher training and the use of model videotapes.

Skill Training

Only a few years before the development of microteaching, much psychological investigation of meaningful learning had focused on programmed instruction. Terms such as "criterion behaviors," "performance criteria," and "behavioral objectives" became a regular part of many educational psychologists' vocabulary. Concurrently, behavioral scientists were working out techniques, primarily under military contracts, which incorporated these ideas along with analytic procedures for determining task requirements and training needs in complex man-machine systems. For example, the tasks associated with the position of radar technician would be stated in terms of the acts the technician must execute on the job. If one criterion behavior was ability to use an oscilloscope for testing the response characteristics of electronic components, then performance criteria could be written stating the kind of data needed and the tolerances which would be allowed for testing each electronic component. Moreover, they could be written in terms of the observable behavior displayed by master radar technicians. Training thus became more efficient. By removing tasks unrelated to job performance and emphasizing tasks critical to job performance, training was streamlined. Because the components of criterion behavior were clearly recognizable by both the supervisors and the trainees, the evaluation of training programs became simple and direct. These techniques could clearly be applied to the performance of teaching. While the same level of analytic description might not be so readily attainable, signi-

ficant aspects of teaching might be defined with a degree of precision not previously experienced in teacher education.

The kind of skill definition possible with the new approach is illustrated by one of the first studies to explore the feedback capabilities of the video equipment (McDonald & Allen, 1967). After viewing many teaching styles in many classrooms, it became apparent that one behavior involved in a competent teaching performance, regardless of subject matter, is the ability to reinforce student participation. Skill in reinforcing seemed lacking in many novice teachers, so training procedures were designed to assist such teachers in acquiring the necessary techniques and incorporating them into their teaching repertoire. The feedback conditions which were studied as independent variables will be reported later in this paper. At this point, only the definitions of the skill will be discussed.

Trainees were provided with a brief statement about the utility of reinforcement and why mastery of reinforcement techniques was considered important. The task assigned to them was to increase student participatory behavior by positive reinforcement of that behavior whenever it occurred. Positive reinforcement was defined for the trainees as classifiable into four categories of teacher behavior: (a) Positive verbal reinforcement -- immediately following a pupil response the teacher uses words or phrases such as "good," "fine," "nice job"; (b) positive nonverbal reinforcement -- the teacher responds to pupil participation by nodding his head, smiling, moving toward the pupil, writing the response on the blackboard; (c) positive qualified reinforcement -- though a response is unacceptable, participation is reinforced by such remarks as "That's good, but...," "Right, but don't forget...," "You're on the right track"; (d) positive post hoc reinforcement -- the teacher recalls a previous positive contribution by a student or asks for repetition of a point made by the student. These four categories were further defined in terms of their negative aspects, with negative examples, showing how certain teacher responses could punish participatory behavior. Thus a teaching behavior presumed to be important in classroom interaction was described in behavioral terms.

Acceptable levels of performance could be agreed upon since the criterion behavior is distinct and measurable. It is clearly observable and can be reliably counted. It is performed frequently, though it takes different forms, and can be acquired like other skilled performances when appropriate training conditions are provided. One training approach that offered great promise both because of its theoretical underpinnings and its reliance on the video equipment to demonstrate skilled teaching performances, was the use of model tapes to aid a teacher in acquiring specific skills.

Modeling

The use of model tapes, i.e., short video recordings of a master teacher performing a lesson to illustrate uses of a specific skill, became the most frequently used means to promote skill acquisition in trainees. Theoretical work on imitative learning (c.f. Bandura & Walters, 1963) suggested that complex behavior could be acquired almost entirely through imitation. It appeared that the provision of models served to accelerate the learning process and in cases where minimum errors were desired, modeling was viewed as a highly effective method of transmitting behavior patterns. Moreover, Bandura, Ross, and Ross (1963) demonstrated that for some patterns of behavior there is little difference between filmed models and live models in their effects on acquisition.

The demonstration of response acquisition from models points to a contiguity theory of vicarious learning, in line with the theoretical and empirical work of Sheffield (1961) and his colleagues. Thus, upon viewing a model, the subject

> acquires through the contiguous association of sensory events, perceptual and symbolic responses possessing cue properties that are capable of eliciting at some time after demonstration, overt responses corresponding to those that have been modeled (McDonald & Allen, 1967, p. 10).

Reinforcement procedures in training, then, control performance variables, while acquisition is effected primarily by modeling variables.

Modeling tapes were typically developed in microteaching classes. In this format, the model teacher repeats a lesson until an excellent

demonstration of the skill is recorded. This process often leads to a sharper definition of the skill itself. Microteaching also allows for experimentation with different ways of demonstrating the skill, including role playing by the students, if necessary. Exaggeration and redundancy in use of the skill is possible, which increases the clarity of the model when presented to trainees. The reduced complexity of the microteaching classroom also allows the skill performance to be highlighted. A more complete discussion of the techniques associated with model tape development can be found in McDonald, Allen, and Seidman (1967).

Model tapes on specific skills are then included in the microteaching procedure for teacher trainees. The trainee views a model performance of a specific skill, then attempts to emulate the demonstration by including instances of the skill in his own microteaching lesson. Both the model's performance of the skill and the trainee's successive microteaching performance can be viewed on videotape any number of times. Usually a supervisor is present during presentation of the model tape and playback of the trainee's microteaching session. The supervisor's role is important for cueing the trainee about the occurence of the skill during the model's performance and for other suggestions and encouragement to the trainee during the playback of his own performance.

The nature of the techniques used becomes clearer in the context of a particular investigation in which the rationale, procedures, research questions, and results of such inquiries into skill acquisition can be examined in detail. For this purpose, a previously unpublished study by the author in which methods for acquiring the skill of higher-order questioning were investigated, will be described. A less detailed discussion of several other skills will also be presented following this illustrative report. The research into each of these other skills has been directed toward defining the various training techniques and strategies which could be used with different teaching skills. Thus, the studies reported represent contributions to training research as well as to teacher education.

The Skill of Higher-Order Questioning

Classroom observation revealed that some teachers intuitively asked questions of high quality, but that far too many teachers over-emphasized questions requiring only the simplest cognitive activity on the part of the students. Questioning as an instructional technique has been recommended to teachers since Socrates first used it to draw out ideas from students.

The steady stream of books and monographs on the "art of questioning" that have appeared over the years (e.g., Young, 1853; Landon, 1899; Monroe & Carter, 1923; Sanders, 1966) attest to the belief that appropriate questioning behavior is an important teacher characteristic. A common theme in this literature is that questioning is the means by which the teacher stimulates thinking, by which he elicits higher-order mental processes such as critical judgment. Dewey (1933) pointed out that thinking itself is questioning. The critical requirement for a "good" classroom question is that it prompts students to use ideas rather than just remember them. The generally accepted premise is that the form of the question serves as the stimulus for eliciting certain kinds of cognitive activities which may range from simple recall to highly complex inferences from data. Questioning behavior, therefore, represent a special area of interest for investigation. In addition to this study of higher-order questioning further work on probing questions (described below), inquiry questions (J. Koran, 1968), analytic questions (M. Koran, 1969), and special forms of higher-order questions (Claus, 1968) has been pursued.

The purpose of the study reported here was to examine training methods designed to promote higher-order questioning behavior in beginning teachers. A procedure was designed to sensitize the novice teacher to the effects of questioning on his students and to provide practice in forming and using questions that elicit complex cognitive activity. The dependent variable measured was the acquisition of the particular teaching skill, higher-order questioning, measured in terms of frequencies of such questions observed under varying conditions.

Three Inquiries

The study was concerned with three questions about the conditions which aid in the acquisition of a teaching skill.

Question 1. The first inquiry was related to differences in skill acquisition as a function of exposure to symbolic or perceptual models. The expression "symbolic modeling" has been used in the psychological literature to describe the modeling function of some written materials. The terms symbolic and written models are considered synonymous in this report. "Exposure to a perceptual model" means that the learner has observed the actual performance of another person who displayed the skill to be acquired. That such a procedure results in behavior modification without discrimination of the relevant cues and in the absence of known reinforcers is well substantiated by Bandura's studies (1965). But when these ideas are adapted to training, two other factors are utilized: (a) discrimination training (Orme, McDonald, & Allen, 1966), which makes aspects of the skill to be learned more salient for the learner, and (b) reinforcement for the acquisition of these skill components. Both these functions are carried out by a supervisor who works with each subject.

In this study, the master teacher was programmed to ask higher-order questions, which constituted the dependent variable, in as great a frequency and in as many diverse teaching situations as possible. This model performance was videotaped and shown to trainees while salient characteristics of the model's behavior were pointed out.

Perceptual models, whether live or on videotape, may present an unnecessarily large number of different cues to which to attend when the particular skill to be acquired is primarily verbal. A written transcription of the model's behavior, however, presents only the verbal component of the skill. Such transcripts of a master teacher's performance may be thought of as symbolic models. This form of presentation can preserve the naturalness of a classroom insofar as it is an accurate

record of student and teacher verbal behavior. Since the symbolic or written model is read rather than transmitted via fixed-pace videotape, the trainee may proceed at his own pace and review continually what has previously been learned. For this study, then, the written modeling condition provided a trainee with the complete transcript of the perceptual model's verbal performance, together with whatever student and supervisory verbal behavior existed in the perceptual modeling condition. Half of the 120 subjects were exposed to perceptual models and half were exposed to symbolic models during training.

Question 2. A second concern was whether presenting negative and positive instances or only positive instances of the behavior to be acquired offered a more significant training effect. A training model could be programmed to present only positive instances of the behavior (a pure lesson) or both positive and negative instances (a mixed lesson). A mixed lesson, in which both higher- and lower-order questions occur, allows for discrimination training with contrasting stimuli. Such a procedure may be more beneficial to a trainee if the contrast provided by a negative case serves to clarify the characteristics of the behavior to be learned. Or it might be ineffective if the mix produced masking or interference effects.

For this experiment a videotape was prepared in which the model used only higher-order questions. An alternate tape was also prepared in which the same model performed almost the same lesson but added lower-order questions, which were inserted into the lesson following almost every higher-order question. Half the Ss who were exposed to a perceptual model viewed a pure lesson containing only higher-order questions. The other half viewed a mixed lesson containing both higher- and lower-order questions. Subjects who received training with the written models also read either pure or mixed transcribed lessons.

Question 3. The third inquiry was concerned with the nature of the practice (or performance opportunities) provided the Ss. In many studies of modeling or imitation learning, the effect has been inferred

from a measure of matching behavior when the learner is placed in a situation identical to that demonstrated by the model.

In adapting the modeling process to teacher training, it must be decided how closely the trainee is to match the model. If matching the model by performing the same lesson in the same way as the model facilitates skill acquisition, would the transfer of the skill to dissimilar situations (i.e., different lessons) also be facilitated? Or, if Ss practice the behavior of forming higher-order questions in a lesson of their own design, will their performance during acquisition or in transfer tests be superior to that of Ss who taught the same lesson as the model? These questions were investigated experimentally by having half of the Ss practice the skill by performing lessons of their own design, while the other half were directed to practice the skill by performing the same lesson as the model. The two practice conditions were labelled "own" and "model" lessons.

Research Design

The three two-way classifications resulted in a 2 x 2 x 2 factorial design requiring eight experimental groups, where main effects associated with these three questions (perceptual vs. symbolic, pure vs. mixed, and model vs. subject's own lesson) could be examined. Designation of experimental groups by number and treatment is given in Table 1.

TABLE 1

Methods of Training for Each Experimental Group

Model Type	Written				Perceptual			
Lesson Type	pure		mixed		pure		mixed	
Practice Conditions	own	model	own	model	own	model	own	model
Group Number	1	2	3	4	5	6	7	8

Procedure

The entire Stanford Secondary Education Intern Class of 1966-67 (N = 120) served as a pool of subjects. All had at least a bachelor's degree, were predominantly recent college graduates, and were in residence at Stanford for one year to obtain a master of arts in education. The experiment was conducted during the interns' first quarter of residence, summer 1966, on five consecutive Saturdays. One additional experimental day was needed late in the quarter for those Ss who missed their regular training session.

Subjects were stratified according to curriculum and a random procedure was then used to assign Ss to one of eight experimental conditions. Random procedures were used to assign Ss to experimental classrooms containing video recording operators, machines, and playback equipment. Classrooms were located at the university and were familiar to all the Ss as a result of their frequent microteaching experiences in these rooms during the summer. Table 2 describes the original sample pool and the final sample utilized in the study.

TABLE 2

Original and Final Sample Size by Subject Matter Areas

	Original Pool by Experimental Group Assignment									Final Sample by Experimental Group								
	1	2	3	4	5	6	7	8	Total	1	2	3	4	5	6	7	8	Total
Social Studies	6	6	5	4	6	6	5	4	42	4	5	5	7	4	4	2	3	34
English	5	5	5	6	4	4	4	7	40	6	4	5	4	3	5	3	7	37
Science	2	2	2	2	1	1	4	2	16	1	2	2	2	2	1	3	2	15
Mathematics	1	1	2	2	3	1	1	1	12	1	1	2	2	3	1	1	1	12
Drama						1	1		2						1		1	2
Art	1	1	1	1	1	2	1		8	1		1			1			3
Total	15	15	15	15	15	15	16	14	120	13	12	15	15	12	13	9	14	103

Because of rescheduling at the end of the study (an effort to balance the number of Ss per condition), occasionally more Ss in a given curriculum area were assigned to an experimental condition other than that to which they were originally assigned. The decrease in numbers was due to scheduling conflicts, equipment malfunction, distortion or erasure of videotapes, and, in the case of 10 Ss, refusal to participate. The final sample used for statistical evaluation is given by practice session and experimental group in Table 3.

TABLE 3

Number of Videotapes Rated by Practice Session and Experimental Group

EXPERIMENTAL GROUP	Session 1	2	3	4
1	11	13	13	13
2	12	12	12	11
3	15	15	13	13
4	13	15	15	12
5	12	12	10	11
6	13	12	13	13
7	7	9	9	9
8	14	14	14	11
Total	97	102	99	93

Teams of four high school students, usually of the same grade level and usually two males and two females, were formed on the morning of an experimental day. These teams were then assigned to classrooms by a procedure which insured that all teams appeared in all rooms for different training sessions throughout the day.

Schedule. A typical training schedule for Ss on any experimental day contained 15 steps and required two hours and 20 minutes. Six Ss at a time would begin a training sequence at 8:00 or 10:25 A. M., or 1:00 or 3:25 P. M. on an experimental day.

Step 1: Written pretest of verbal fluency and flexibility. Two tests from the ETS Kit (French, Ekstrom, & Price, 1963) were administered to assess possible correlates of the higher-order questioning skill. While not used in this study's analysis, the inclusion of such data, representing a search for aptitude treatment interactions, is one that has become a part of later studies (c.f. M. Koran, McDonald, & Snow, 1969).

Step 2: Teaching Session 1. Subjects presented a five-minute lesson of their own choice prepared in accordance with instructions to include questions to their students. Data from Teaching Session 1 provides a record of Ss' performance under these minimal preexperimental instructions.

Step 3: Brief instructions and description of the training. The training schedule and the nature of the training task were presented to the S in written form by the TV operator within the classroom.

Step 4: Presentation of Model Lesson 1. Depending on their assignment to an experimental condition, Ss were exposed to the video or written model demonstrating a pure or a mixed lesson. During the presentation of the video model, a separate audio recorder (synchronized to the videotape) was used to provide a standard commentary to discriminate important behavior in the model's lesson. These comments were also included in the written transcripts and appeared in the same form and place in the lesson. This represents an attempt at "automating" the role of the supervisor, here, and in step 5. This was a departure from STEP's custom of using live supervisory personnel.

Step 5: Playback of Teaching Session 1. All Ss viewed a video recording of their first teaching session. During this self-viewing time (a performance feedback condition), the audiotape was used to direct Ss' attention to the form of questions used in their lesson. The form of this commentary was noncontingent but task orienting.

Step 6: Planning for Teaching Session 2. Subjects were informed that they would either teach their own lessons again or that they

would teach the same lesson as the model. In both cases subjects were instructed to practice the training task.

Step 7: Teaching Session 2. Subjects taught their own lesson or the model lesson to a different team of students.

Step 8: Presentation of Model Lesson 2. Subjects were exposed to a different model lesson, but in the same form and via the same media used in step 4.

Step 9: Playback of Teaching Session 2. Same as step 5.

Step 10: Planning for Teaching Session 3. All Ss continued to plan either own or model lessons.

Step 11: Teaching Session 3. Same as step 7.

Step 12: Review of Model Lessons 1 and 2. All Ss repeated their experience in steps 4 and 8.

Step 13: Playback of Teaching Session 3. Same as step 5.

Step 14: Planning of new lesson. All Ss were instructed to plan a completely new lesson on any topic they chose. They were to demonstrate transfer of the skill in their next teaching session.

Step 15: Teaching Session 4. In this final teaching segment in the training sequence, all Ss were evaluated for transfer effects.

Such a procedure has been typical of almost all studies of microteaching. The sequence starts with the collection of base line data, includes exposure to models, self-viewing, and repeated chances to practice teaching in the micro environment.

Rating. After the study was completed, stenographers transcribed the audio recording of the tapes, producing typed protocols of the subjects' questions in each of the four teaching sessions. Ratings of the questions were made from the typed protocols rather than from the video recordings of the teaching sessions. This procedure was followed because of anticipated difficulty in rating questions as

higher or lower order. The static written protocol was expected to be more amenable to reliable rating than the dynamic video recording.

Three male secondary school teachers, all in graduate study at Stanford, rated the typed protocols. Questions were rated higher or lower order on the basis of two substitution rules. In essence, this was the working definition of higher- and lower-order questions:

a. Can you substitute the verbs "remember" or "describe" in the question? If so, the question is lower order. If not, and such verbs as "infer," "interpret," and "synthesize" can be substituted in the questions, the question is higher order.

We chose to regard simple observation and simple recall, where answers are available in memory, as lower order. To illustrate, the question "How many people were in the room?" calls for concrete facts available from memory. The question "How many people are in the room?" calls for an answer which is available to direct observation. In neither case is cognitive activity regarded as higher order. However, the question "Can you infer something about the relationship of the people in the room?" requires considerably more cognitive work and is classified as higher order.

b. Determine whether the question asks the student to apply a rule or produce examples of a principle (lower-order question), or whether it forces him to find a rule or discover a principle (higher-order questions).

Raters also had available three other categories into which they could classify questions. The first and second of these were "repeat of higher-order questions" and "repeat of lower-order questions." In each case the category was used when the teacher had asked the same question, or repeated the basic question in similar form or sought additional answers from the students. The third category, infrequently used, was for incompleted, unintelligible, unclassifiable, or obviously rhetorical questions. Questions placed in this category were ignored in subsequent data analysis.

Raters, as a group, were given approximately ten hours' training and then instructed to work independently on the protocols. Each rater categorized the questions in 391 protocols, working blind with respect to the experimental group of the Ss, but with knowledge of the teaching session. The design of the experiment was not fully explained until the rating had been completed.

The protocols used were shortened versions of the lessons presented by each teacher, and included only the teacher's comments for context, and the teacher's questions. Additional context and student answers were not included. Ratings of the questions had to be made on the basis of the rules stated above, and the categorization of higher-order questions under these rating conditions was quite conservative.

Results

Reliability of the ratings was analyzed for each session, using the analysis of variance procedure described by Winer (1962). This analysis provides two correlation coefficients: (a) the reliability of a single measurement which approximates the mean of the intercorrelations between any pair of judges and (b) the reliability of the mean rating by the judges. This latter coefficient may be interpreted as if it were the correlation between two sets of mean ratings for the same people, where two random samples of judges were used. The stipulation requiring that the judges be a random sample from a population of judges was violated in this study, and the estimates of reliability are, to some extent, in error. However, this correlation is perhaps the most appropriate way to describe the data since the scores assigned to Ss were the average of the ratings of the three judges. The mean ratings by judges were chosen to provide a more stable estimate of the true scores of Ss.

Table 4 provides reliability information about the rating categories used in subsequent analyses. The adjusted correlations represent a correction for differences in frame of reference of the judges. Because the zero points on the scale of measurement are not as important as the dispersion or order of scores, any systematic variation between judges need not be considered as part of the error of measurement. Where

large adjustments of the correlations appear in Table 4 it may be assumed that large differences in frame of reference between the judges were operating.

The reliability estimates of the average intercorrelation between any pair of judges, which were also obtained, were low before adjustment and reflected only moderate interrater agreement after adjustment.

The dependent variable chosen for analysis was the total number of higher-order (and repeat of higher-order) questions, divided by the total number of questions asked in a teaching session. The transformation of the original values into percnetages allows for ceiling effects created by the five-minute time limit on a teaching session.

TABLE 4

Unadjusted and Adjusted Reliability of the Average Score Assigned by Three Judges to Four Categories in Each Training Session [a]

Category	Teaching Session			
	1	2	3	4
Number of higher-order questions	(.694)	(.564)	(.276)	(.325)
	.745	.657	.660	.629
Number of higher-order and repeat of higher-order questions	(.612)	(.539)	(.207)	(.360)
	.683	.653	.678	.627
Number of lower-order questions	(.859)	(.854)	(.312)	(.639)
	.910	.889	.717	.874
Number of lower-order and repeat of lower-order questions	(.880)	(.865)	(.333)	(.654)
	.919	.896	.745	.865

[a]Unadjusted reliability coefficients are in parentheses.

The data for Teaching Session 1 were analyzed using a simple one-way analysis of variance between the eight experimental groups. Table 5 shows the results of this analysis, indicating that there were no initial differences between groups.

TABLE 5

One-Way Analysis of Variance on Eight
Experimental Groups in Session 1

Source	SS	DF	MS	F
Between Groups	.056	7	.008	.33
Within Groups	2.141	89	.024	
Total	2.197	96		

Using Session 1 as a base, the effects of training over the four sessions are shown graphically in Figure 1.

The training effect shows, for example, that within experimental Groups 5 and 8, the increase in percent of higher-order questions asked by a teacher has gone from 19 and 21 percent in Session 1 to 51 and 55 percent of all questions asked in Session 3.

The Wilcoxon matched-pairs signed-ranks test (Siegel, 1956) was used as a quick though not particularly powerful way to determine the probability associated with mean changes between sessions (Table 6).

TABLE 6

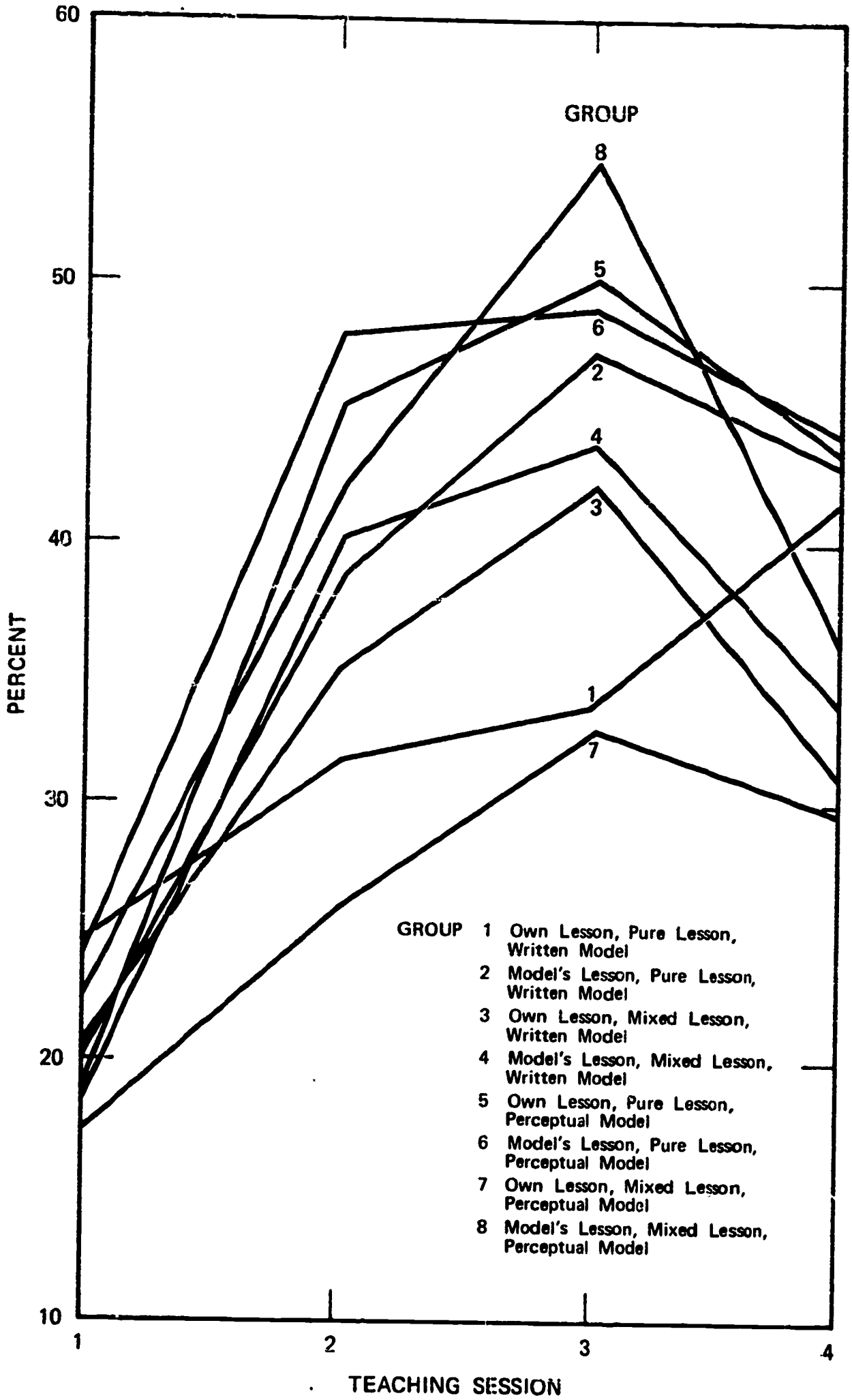
Wilcoxon Matched-Pairs Signed-Ranks Data on Mean Changes
Between Sessions for Eight Experimental Groups

Differences	T Value	Probability	Direction of Difference
Session 1 and Session 2	0	.005*	S2 > S1
Session 1 and Session 3	0	.005*	S3 > S1
Session 1 and Session 4	0	.005*	S4 > S1
Session 2 and Session 3	0	.005*	S3 > S2
Session 2 and Session 4	18	NS	———
Session 3 and Session 4	5	NS	

* One-tail tests of significance

FIGURE 1

MEAN PERCENT OF HIGHER-ORDER QUESTIONS FOR EIGHT EXPERIMENTAL GROUPS ON FOUR TEACHING SESSIONS



The pairs used in this analysis were the eight means in one session versus the eight means for another session. One-tail tests were appropriate for testing the significance of the changes between sessions since the direction of change was predicted. As predicted, and displayed in Figure 1, acquisition of the skill continued over the three trials. A drop-off in performance in Session 4 was also predicted since lessons were switched. However, even here, the null hypothesis of no difference between Session 3 and Session 4, and no difference between Session 2 and Session 4, is not rejected. While the first interpretation is to claim no significant drop-off in Session 4, Figure 1 shows this to be primarily a function of the continuous rise, over all training sessions, of Group 1. Seven other experimental groups did fall off between Sessions 3 and 4.

Tables 7, 8, and 9 present the analysis of variance summary for Sessions 2, 3, and 4 respectively.

TABLE 7

Analysis of Variance for Percent of Higher-Order Questions in Teaching Session 2

Source	DF	MS	F
Model (Written vs. Perceptual)	1	.038	1.23
Lesson (Pure vs. Mixed)	1	.062	2.00
Practice (Own vs. Model's)	1	.150	4.81*
M x L	1	.135	4.34*
M x P	1	.008	.26
L x P	1	.037	.69
M x L S P	1	.037	1.17
Error	94	.031	

* Significant beyond the .05 level.

TABLE 8

Analysis of Variance for Percent of Higher-Order Questions in Teaching Session 3

Source	DF	MS	F
Model (Written vs. Perceptual)	1	.054	2.30
Lesson (Pure vs. Mixed)	1	.007	.31
Practice (Own vs. Model's)	1	.187	8.00**
M x L	1	.038	1.63
M x P	1	.007	.31
L x P	1	.015	.66
M x L x P	1	.204	8.73**
Error	91	.023	

** Significant beyond the .01 level

TABLE 9

Analysis of Variance for Percent of Higher-Order Questions in Teaching Session 4

Source	DF	MS	F
Model (Written vs. Perceptual)	1	.000	——
Lesson (Pure vs. Mixed)	1	.276	10.92**
Practice (Own vs. Model's)	1	.015	.61
M x L	1	.000	——
M x P	1	.001	.04
L x P	1	.007	.26
M x L x P	1	.001	.06
Error	85	.025	

** Significant beyond the .01 level

The tests of main effects were of primary interest, and the significant F test for the practice variable in Session 2 and again in Session 3 indicates that for the acquisition phase matching the model lesson very closely does produce a higher percentage of higher-order questions. Interestingly, though, on transfer to another teaching task, such consistent differences in practice do not hold up. The significant interaction of model and lesson type in Session 2 and model, lesson type, and practice in Session 3 are difficult to interpret meaningfully. It is likely that these interactions resulted mainly from the performance of Group 1 in relation to the generally similar profiles of other groups and are thus not of particular interest.

In Session 4 on the transfer task, a main effect for lesson type was found. Although this effect did not appear for other sessions, the training done with the "pure" lesson, modeling only positive instances of the skill, aided Ss in using the skill in new teaching situations.

No significant differences were found related to the media with which the model was presented. It appears that for a verbal skill such as higher-order questioning, the video technology used to present the model may be superfluous, and that training may be as readily accomplished through written models. However, an overall training effect may be mediated by the constant treatment (in this study) of self-viewing by means of a videotape. There is no information about such an effect from this study.

Conclusions

For this sample of Stanford interns in secondary teaching, training in the use of higher-order questions was successful. As measured by percent of higher-order questions used in a five-minute teaching session, all experimental groups showed significant training effects. It appears that for this skill the perceptual model was no more efficient as a training agent than the written model. Whether this would be true for other skills, especially those involving motor behaviors, is not known.

The careful matching of the model lesson during acquisition was effective in producing a greater number of higher-order questions. However,

no significant transfer of this skill to a new lesson was noted. Whether an effect would be apparent if more practice were given is not known. All curves were still rising on Session 3, indicating, perhaps, that another training session might have been useful before the attempt was made to transfer. The effectiveness of training by showing only positive instances of the skill appears when a transfer test is made.

The description of this study of higher-order questions served as an example of the style of research and methods of analysis which had been undertaken in the investigations of microteaching. Each study in the skills series was different, but most share something in common with the design and analyses discussed above.

Further Study

A subsequent study of higher-order questioning by Claus (1969) also investigated the acquisition of this skill, but manipulated as the independent variable the presence or absence of cueing by the experimenter during the presentation of the model tape or the presentation of the trainees' own videotaped microteaching performance. For this study, Claus adapted Bloom's (1956) Taxonomy to form eight categories. Each question asked by both the model and the trainee was classified in one of these categories. An experimenter did the classifying and informed the trainee into which category each question fit; this was called cueing. Questions which requested factual information or opinions were classified as lower-order, while higher-order questions were considered to be those that required translation, application, interpretation, synthesis, analysis, or evaluation. The experimenters were trained to categorize the questions reliably as they occurred during the four 10-minute microteaching performances attempted by each trainee (40 elementary teaching majors) and to inform the trainees, i.e., cue them, as to the classification.

Four experimental groups were used. In Group 1, a supervisor categorized questions during both the presentation of the model and the viewing of the trainee's own performance. For Group 2, the supervisor was present only during the presentation of the model. Group 3 had the supervisor present only during the self-viewing session. Group 4

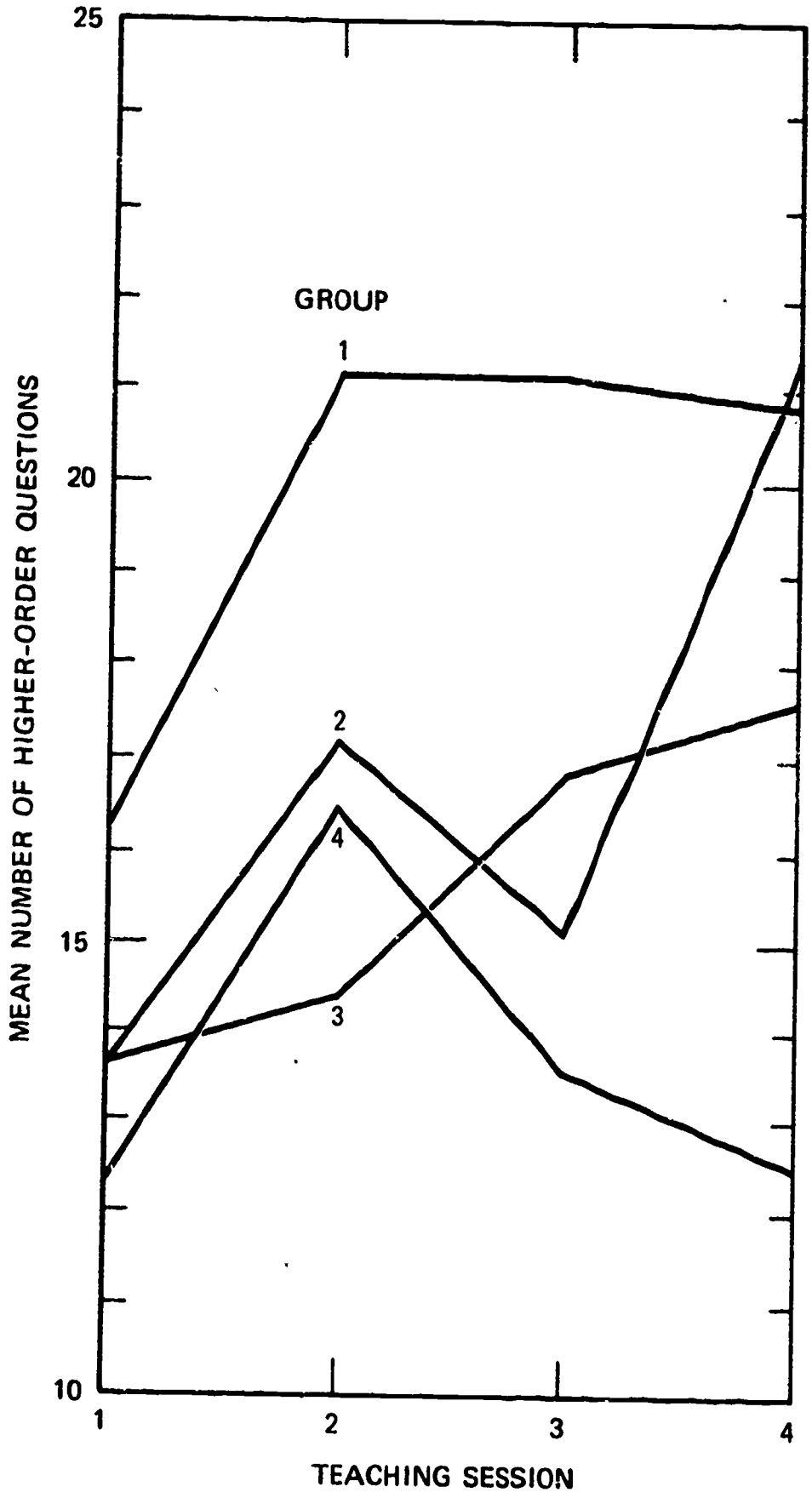
worked without a supervisor present. The data from this study are presented in Figure 2, displaying the mean number of higher-order questions asked by each group for each teaching session. It appears that the live experimenter (Groups 1-3 vs. Group 4) is seen as an important component in training with videotaped models. But more interesting, perhaps, is the fact that the presence of the supervisor is more potent during the presentation of the model than during the feedback or self-viewing stage (Group 2 vs. Group 3). Along these same lines, providing a supervisor at both stages in the training process is little different from having him work only during the time the model is presented (Group 1 vs. Group 2). The reader may refer to the original report (Claus, 1969) for a complete discussion of how these findings accord with the current formulations of social learning theory and vicarious processes (Bandura, 1968, 1969), and for more complete data analyses than can be presented here.

The Skill of Reinforcement

Definitions of the skill of reinforcement have been provided above in the section on skills. The study summarized here was concerned with the acquisition of the skill of using positive reinforcement as a means of increasing student participation. Each S in the study was videotaped in their regular classroom four times over a period of a few weeks. The first taping was used for base line data on the teachers' "natural" use of reinforcement for student participation. Manipulated variables were the amount of reinforcement and discrimination training which the intern received during the playback of the videotapes. In Group 1, control group Ss viewed the playback of their tapes alone, having been directed to detect instances of effective teaching behavior. Group 2 also viewed their videotaped playback while alone, but were directed to watch for instances of their reinforcement of pupil participatory behavior. This was called the self-feedback group. Group 3 viewed their playback of classroom teaching with an experimenter present who reinforced the intern teacher each time a pupil participatory response was reinforced by the teacher. This was called the reinforcement condition. Group 4 shared the same conditions as Group 3, but in addition the experimenter

FIGURE 2

MEAN NUMBER OF HIGHER-ORDER QUESTIONS BY EXPERIMENTAL GROUP AND TEACHING SESSION



provided discrimination training, e.g., pointing out the salient cues to which the intern teachers could attach reinforcement, suggesting ways of providing immediate reinforcement, explaining the effects of reinforcement on student behavior.

The four videotapes per S were rated for different kinds of reinforcement techniques and for the occurrence of certain pupil behaviors. Interrater agreement was high, approaching unity for most of the responses of interest. The frequency of positive verbal reinforcement which was used in tapes 2, 3, and 4 (corresponding to training trials) were analyzed using the tape 1 data, i.e., the base line data, as a covariant. Table 10 presents these data.

TABLE 10

Adjusted Mean Frequency of Positive Verbal Reinforcers by Tape and Group

	Videotape Number		
	2	3	4
Group 1	30.5	18.6	27.0
Group 2	30.2	28.8	23.5
Group 3	45.2	33.5	26.1
Group 4	60.9	50.7	47.2

Significant F ratios, indicating differences among groups, were obtained for each taping session. The ordering of the means suggests that the condition which provides for discrimination training and reinforcement provided by an experimenter (Group 4) is the most effective. Reinforcement provided by an experimenter (Group 3), although more effective than having an S working alone (Group 2), is significantly enhanced when used in conjunction with discrimination training (Group 4) which makes the behavior to be mastered more salient. The data from the control group and the self-feedback condition (Groups 1 and 2) were quite similar. The drop in frequency over taping sessions was anticipated,

since reinforcement for participation increased the duration of the pupils' responses, limiting the opportunities for the trainee to demonstrate acquisition of the skill.

The data analysis also showed similar findings for the category called positive nonverbal reinforcement. A concomittant reduction in negative teacher comments was also noted. Data were obtained for the number of pupil participatory responses made and on the intercorrelations among the various response categories of the dependent variable. For a complete description of the study see McDonald and Allen (1967) or McDonald, Allen, and Orme (1966).

The Skill of Probing

Probing is defined as a basic questioning technique through which the teacher requires students to go beyond the response they first made. The skill was chosen because of the tendency for teachers, especially novice teachers, to let student responses "slide" by, accepting almost anything students gave in the way of verbal behavior. The goal was to develop a teaching style that included the ability to ask penetrating and probing questions after the student had made a verbal response. The probing techniques described to the trainees were:

a. Clarification. The teacher asks the pupil for more information and/or to supply more meaning. Examples include teacher statements such as: "What do you mean?" "Please rephrase that." "Can you explain that further?"

b. Increasing critical awareness. The teacher requires the pupil to justify his response rationally. Examples include such teacher comments as: "What are you assuming here?" "Why do you think that is so?" "How would someone with the opposite point of view respond to that?"

c. Refocusing. Rather than proceeding deeper into an area with a pupil, the response may call attention to other related areas. The teacher may then refocus by saying, "What are the implications of this for . . . ?" "How does that relate to . . . ?" Take it from there and tie it into . . . ."

d. Prompting. The teacher does not allow an "I don't know" or "I'm not sure" pupil response to pass without trying to extract some of the information which was requested. The teacher may hint or prompt by refering back to material that is known by the pupil, e.g., when a pupil cannot define microteaching, the teacher's verbal pattern may be, "Well, what does micro mean?" "O.K., what does teaching mean?" "Now can you put that all together?"

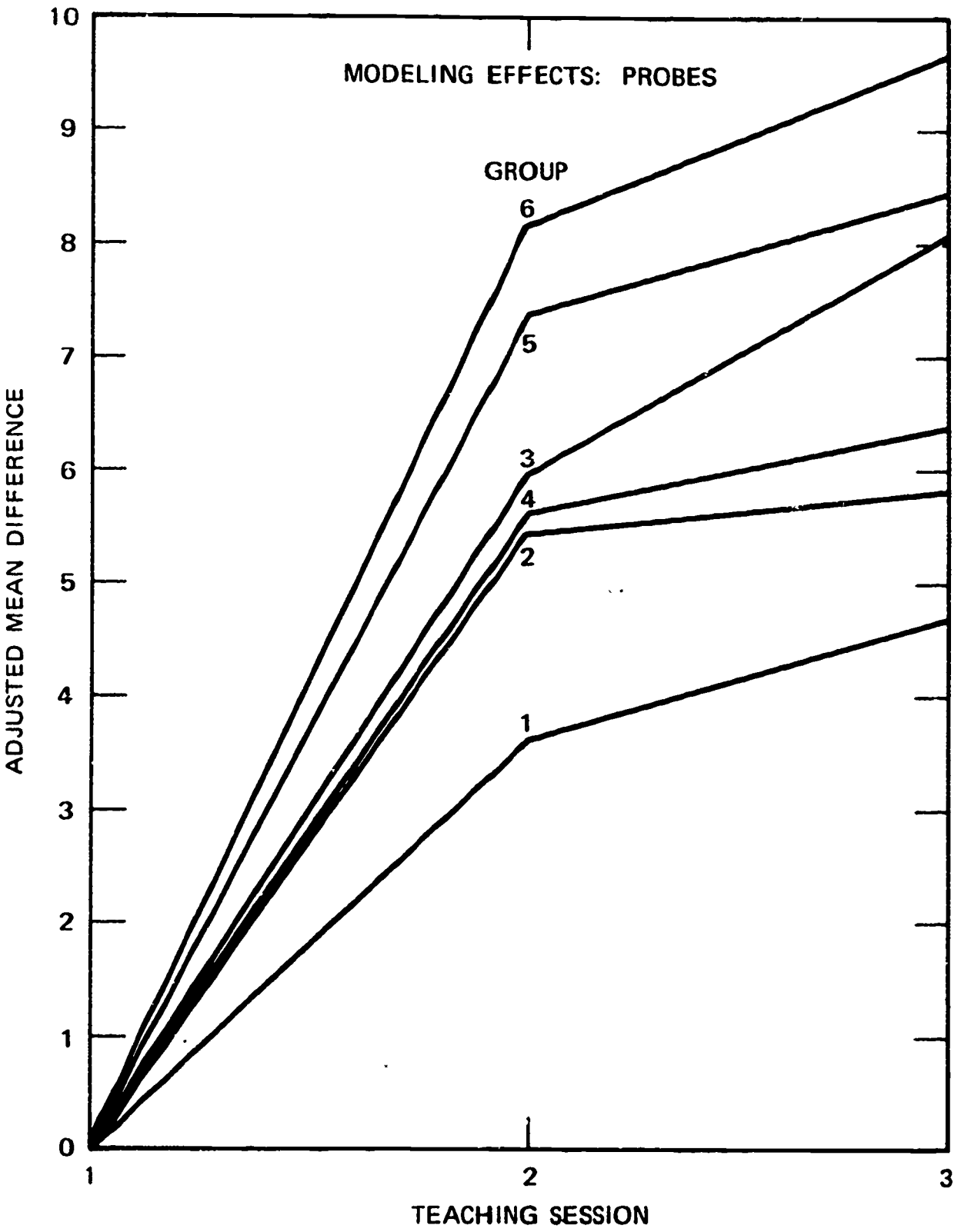
e. Redirection. This is a teacher verbal behavior that involves other pupils in the interchange that is taking place. To a student other than the one who has just spoken, the teacher may say, "Can you add to that?" "What are your views on that?"

The skill of probing was to be acquired by six groups of trainees, 17 to 20 Ss per group. All Ss taught an initial lesson in which they were told to include interaction with their pupils. Following the recording of what was to become base line data, all Ss received information about the skill of probing, much like the definitions of the skill provided above. Then, Groups 1, 3, and 5 viewed the playback of their first teaching session alone, while groups 2, 4, and 6 saw the playback of their first teaching session with an experimenter/supervisor providing discrimination training and reinforcement when the teacher displayed probing behavior. In the next stage of training, Groups 1 and 2 reviewed the written material, Groups 3 and 4 viewed a model tape while alone, and Groups 5 and 6 viewed a model tape with an experimenter. This sequence was repeated following a second microteaching session and ended after the third microteaching session had been recorded on videotape. This experimental design was chosen to shed light on questions about the nature of the modeling variable, symbolic or perceptual, and the contribution of supervision during feedback via the videotape.

Figure 3 shows the acquisition curves for the six experimental groups over the three teaching sessions. All groups were adjusted to a common base line on Trial 1, using the data which was collected during that teaching session. The different varieties of probing were rated reliably for each teaching session, and the outcome by group and teaching trial is shown. Clearly, Groups 5 and 6, each of which had

FIGURE 3

ADJUSTED MEAN DIFFERENCE BETWEEN TEACHING SESSIONS 2 and 1, AND SESSIONS 3 and 1, FOR EACH EXPERIMENTAL GROUP



been exposed to a perceptual model with an experimenter present, showed maximum skill acquisition. Group 6 viewed the teaching playback with an experimenter present, and Group 5 viewed the playback alone. The presence or absence of someone in a supervisory role providing discrimination training and reinforcement does seem to be an important variable in the acquisition of complex teaching skills when training occurs with models and the videotape system. All data analyses showed small but consistent differences favoring Group 6. The data support the conclusions that for the probing skill symbolic modeling (Groups 1-2) was not as effective as perceptual modeling (Groups 3-6), and that the experimental conditions richest in feedback (Groups 5 and 6) were more potent than those conditions weaker in feedback (Groups 3 and 4). The original report provides a complete description of the hypotheses under study, the data analyses, and the conclusions (McDonald & Allen, 1967; Orme, 1966).

The Skill of Varying the Stimulus Situation

The contemporary investigation of attention, particularly the theoretical and empirical studies by Berlyne (1965), directed inquiry into controlling attention in the classroom. Classroom observations pointed out that many teachers, novice and experienced, do not maintain the students' attention, as evidenced by boredom cues (e.g., hair combing, doodling, note passing). On the other hand, some teachers seemed to have a gift for controlling the attentional processes of their students throughout an instructional sequence. Analysis of these teachers, often called "hams" by themselves and their colleagues, revealed that at least some of their techniques could be described in terms of observable behaviors. It therefore became possible to conceive of training teachers to acquire the skills which seemed related to control of attentional processes.

A training sequence was developed which was aimed at making teachers aware of themselves and their own behavior as the prepotent stimulus object in the classroom. Teachers were taught that attention is maintained through variation in the stimulus field. Objects in or characteristics of the environment which are in flux are more likely to be monitored

than objects or characteristics which are static. The production of changes in teaching behavior which might produce or maintain attentional processes in students became the training goal. Such techniques were viewed as a necessary, though not a sufficient, condition for learning. The trainees were advised not to feel limited to performing the relatively simple acts they were being taught, but to devise stimulus variations to suit themselves and their unique teaching styles. Six areas were defined in which they could practice variation in the environment. Abridgements of the definitions they received follow:

a. Movement. Movement around the classroom produces visual and aural sensory adjustments by the students. A high number of these sensory adjustments, per unit time, should help the teacher to keep students attending to the message. Short of continuous movement, which may be distracting, the teacher should be utilizing the front and back of the teaching space, as well as the left and right sides of the classroom. Moving among and even behind the students should also produce the stimulus variation thought to be important.

b. Gestures. Teachers can try to be more expressive and dynamic through gestures when talking with the class. Hand, head, and body movements constitute as important a means of communication as does verbal communication and should be used for conveying meaning. Gestures allow for variation in the kinds of communication used, and variation is the component stressed in this training exercise.

c. Focusing. Specific verbal or gestural behavior can focus the attention on any desired object. Verbal focusing can be accomplished through certain key words such as in the sentences, "Look at this diagram." "Listen closely to this!" "Watch what happens now." Gestural focusing can occur when the teacher points to an object, or when the teacher bangs on the blackboard for emphasis. Combinations of the two will also occur.

d. Interaction styles. Vary the style of interaction that occurs throughout the presentation. The teacher can go from lecturing and demonstrating to all students, to an interchange with a single student, to stimulating student-to-student discussions or commentaries. The latter

situation calls for the teacher to remove himself briefly from the lesson so that the interaction pattern is perceived as having changed.

e. Pausing. Silence is an attention-producing behavior. The deafening sound of silence occurs when it follows units of verbal behavior to which students may have adapted. Try to pause for a length of time sufficient to be perceived as a changed stimulus field and see the effects it has on pupils.

f. Shifting sensory channels. Use tactile senses when possible. Switch communication from the oral to the visual sense by sometimes putting key words or concepts on the blackboard without saying them. The students must then shift their sensory channels as the teacher shifts the primary media used to transfer information.

This potpourri of techniques was used by teachers in a microteaching situation in which they taught three times. Basically, the design of the study was concerned with the effects of positive and negative modeling behaviors. All Ss in experimental Group 2 saw a videotaped model perform a five-minute microteaching lesson demonstrating the behaviors to be acquired. The Ss in Group 3 viewed the same lesson performed in a dull listless manner, with the same model teacher performing none of the behaviors to be acquired. Subjects in Group 4 were exposed to both the positive and negative tapes portraying the same model and lesson content. The effects of contrasting the two model performances were to be examined. Subjects in Group 5 were used as controls and received no exposure to videotaped models. The Ss in Group 2-5 all had an experimenter/supervisor with them to provide aid, encouragement, and discrimination training during playback of their own teaching performance and during the presentation of the model tapes in Groups 2-4. When the negative model was shown, the experimenter pointed out the missed opportunities to engage in stimulus variation. Group 1 was a special pilot group to investigate the potential of a prerecorded commentary by the experimenter for use with a model tape. The Ss in this group therefore received no contingent reinforcement or aid but were exposed to a prerecorded set of supervisory comments synchronized to the positive model and designed

to aid them in their task. All Ss (N=89) taught the first lesson in a natural manner, under no special instructions, and were then given written statements and definitions about the skill to be acquired.

Reliable ratings of the videotapes were obtained on the categories of behaviors described above. Figure 4 shows graphically (a) the acquisition of increased movement responses as measured by time spent in movement, (b) virtually no change in time spent in gesturing, and (c) a slight increase in use of focusing over the three sessions. These data are quite typical of what was obtained, showing little in the way of between-group differences (for that reason the groups are not identified in the graph) and little in overall training effects. In fact, for the variable "number of gestures," there occurred a considerable drop in frequency over the three sessions. Through training effects seem confused when group means are discussed, some individual cases will serve to point out that some skill acquisition took place. Table 11 presents data from selected Ss in different training groups. This presentation of individual data is not intended to divert attention from the rather distorted and confusing group data obtained, but to illuminate the acquisition of certain behaviors for some Ss who were, in essence, receiving what the instructors thought was some sound advice about teaching technique.

Subject number 84 in Table 11 (the last S reported) showed a change from a lecturer tied close to the lecturn in Session 1, to a teacher moving far afield throughout the lesson in Session 3. She was also a person not much given to gestural behavior, and again these data indicate an increased rate of expression in this area.

Unfortunately, no ratings of qualitative changes were made of teacher dynamism, expressionism, or "hamming it up," but some rather startling transformations were reported, anecdotally, by the experimenters. Furthermore, the raters of the videotapes, shown the three teaching performances of a trainee in random order could, with remarkable accuracy, select the true order of the tapes. Their rankings were not bases solely on a general polishing of a lesson which usually occurs

FIGURE 4

CHANGE IN MAGNITUDE OF SELECTED VARIABLES BY TEACHING SESSION

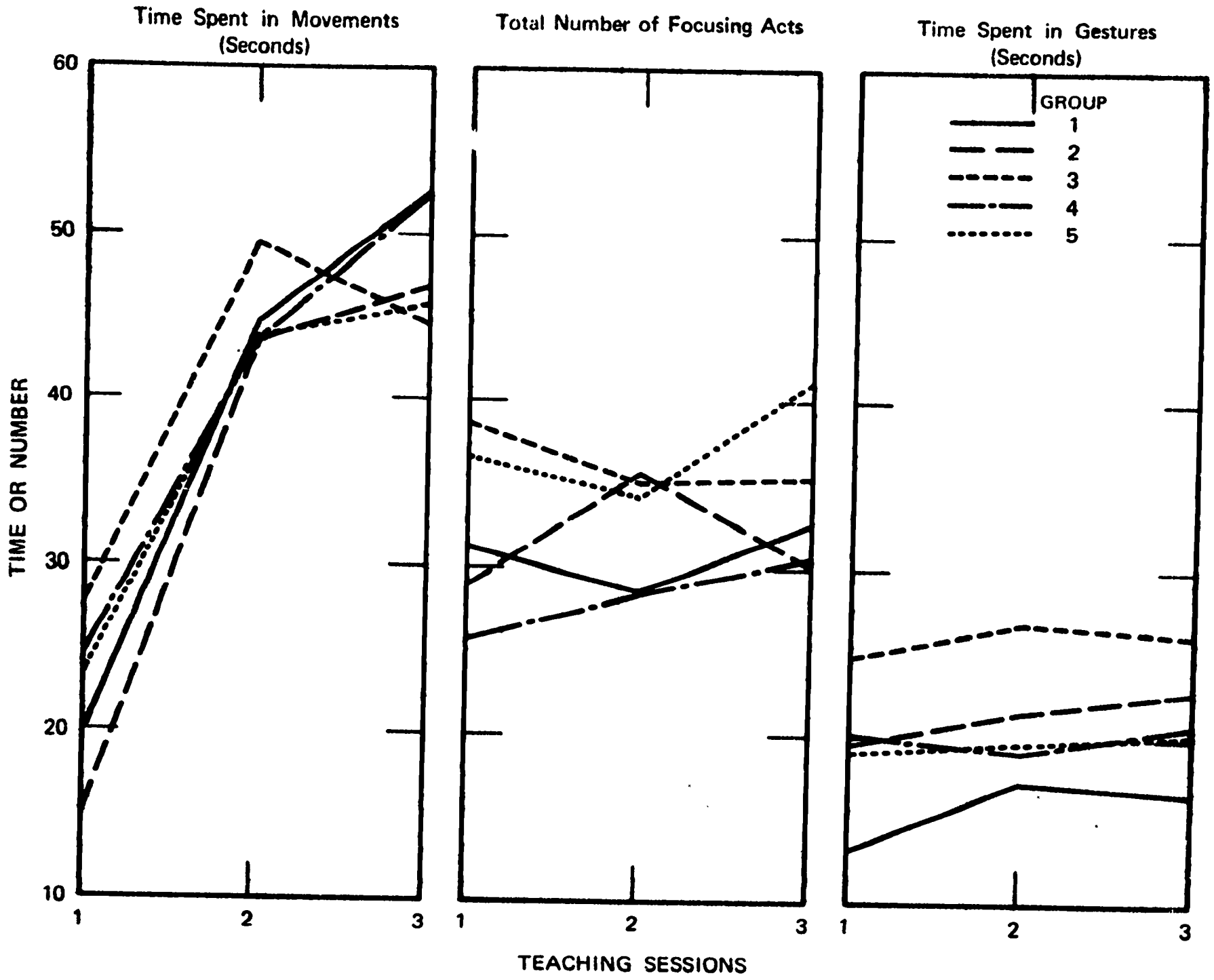


TABLE 11

Some Evidence of Acquisition of Selected Variables in Training for Varying the Stimulus Situation

Subject#	Group	Variable Reported	Microteaching Trial 1	Trial 2	Trial 3
58	4	Number of movements[a]	2	4	13
		Time spent moving (seconds)	8	12	25
		Number of gestures[b]	12	67	93
		Time spent gesturing (sec.)	9	41	59
		Number of focusing acts	2	23	26
		Number of oral-visual switches	0	6	8
35	2	Number of movements	0	21	19
		Number of focusing acts	2	16	32
		Number of oral-visual switches	0	7	11
51	3	Number of movements	2	16	19
		Time spent moving (seconds)	3	33	52
43	3	Number of movements	3	22	21
		Time spent moving (seconds)	2	43	32
		Number of focusing acts	7	26	49
		Number of oral-visual switches	1	6	11
		Number of pauses	0	0	1
72	1	Number of movements	8	18	25
		Time spent moving (seconds)	5	80	80
		Number of gestures	63	75	94
		Time spent gesturing (seconds)	32	20	54
		Number of oral-visual switches	1	5	6
84	5	Number of movements	4	13	30
		Time spent moving (seconds)	7	26	56
		Number of gestures	59	71	75
		Time spent gesturing (seconds)	16	18	30
		Number of focusing acts	11	20	24

a. Movements were defined as any clearly demarked change in position which had a start and a stop. Thus continuous movement, i.e., pacing, would have been counted as one movement.

b. Gestures were defined also as any arm, head, or body movement which had a distinct start and stop. After considerable training, inter-rater agreement for these variables was between .85 and .95.

when a teacher performs the same lesson three times in under two hours, but partly on behavior changes by the teacher in the direction of increased gusto, energy, and showmanship. Almost all reports of behavior change of this type are anecdotal and must be accepted very tenuously.

The Skill of Silence and Nonverbal Communication

The study of stimulus variation techniques, as described above, revealed that teachers, like most people, abhor silence. Silence in social interaction is disconcerting. It was, therefore, a useful tactic for teachers to acquire, providing assurance for themselves that they can be omnipotent in their classrooms. The use of silence has attention-producing and maintaining capabilities. It also aids in partitioning ideas into definable segments which might then be easier for the learner to process. Most important, the use of silence is a powerful control technique over a student's participatory behavior, since the teacher can literally force a student response through utilizing the discomfort and strain that silence induces in the participants in social discourse.

Along with training in the use of teacher silence as a control technique, trainees were made aware of the potency of communication through nonverbal means. Analysis of the interpersonal effects of such stimuli as a raised eyebrow, a frown, a cocked head, a nod, a smile, and other gestures with shared understandings, was judged relevant to the training of good teachers. This was good practice for trainees because of the clear control properties associated with nonverbal communication and because classroom observations revealed that some teachers were emitting discrepant verbal-nonverbal behaviors during student interactions. Some examples of such discrepancies included the teacher who said "good" to a student response while frowning, and the teacher who tried to punish a student by means of negative remarks, while her eyes were twinkling and her lips were smiling. Thus, sensitization to nonverbal behavior represented an important training possibility that fit with training in the use of silence. Trainees could study the effects of silence on others while practicing nonverbal communication.

Only one initial study of training procedures in this area was carried out. Verbal reports from the trainees and their supervisors were all positive in attitude toward and perceived importance of the training experience. The only difficulty encountered in training was in trying to match the model completely, since a five-minute micro-teaching lesson was taught by the model almost entirely without speaking while classroom interaction was controlled through nonverbal means. (Berliner, 1966). The use of silence did increase over trials as did the frequency of nonverbal communication, though rarely approaching the time and frequency levels demonstrated in the model tape.

The Skills for Control of Small Group Discussions

Modern school staffing programs and designs for scheduling of students and instructors emphasize small-group approaches to learning. The recognition that different styles of leadership in small groups produce different effects was discussed in the teacher training program. A study was carried out to obtain pilot information about the possibility for skill training in this area, but no systematic experimental data were collected.

Each trainee was exposed to a 12-minute model tape, showing a teacher and small group. The tape switched from a demonstration of teacher centeredness to a demonstration of student centeredness, to a demonstration of a technique called flexible control in small group work. When the model demonstrated the kind of processes involved in a teacher-centered group, he showed strong control techniques, insuring that the teacher was the center of discussion. Most responses were directed toward him and most questions came from him. Discussion was strictly guided by his plan, and any contributions perceived as wayward or irrelevant were stopped to return to the basic plan. The teacher intervened often, particularly at critical junctures, to channel discussions toward his goal, the questions sought specific answers, and few debatable questions were entertained. In short, there was no interaction without teacher guidance.

When the model switched to a style defined as student centered, he demonstrated much more tolerance for rambling in the conversations. Student excitement was capitalized upon, even when it departed substantially from the lesson plan. The teacher used minimal verbal and nonverbal control techniques. He relinquished the role of rewarding and punishing student behavior. He tried to reduce the high frequency of remarks addressed to him, and the deference shown to him, making the students control the behavior of their peers. The teacher's remarks were used primarily to bring out nonspeakers and stimulate discussion through probing questions.

In addition to the styles outlined above, the model demonstrated flexible control, a middle-of-the-road approach. It was emphasized to the trainees that there is no right or wrong approach, but that the teacher should be aware of what can be accomplished if either extreme is used. Differences in teaching effeciency and in student attitudes toward the subject matter can be expected, depending on which style of control the teacher wishes to adopt.

Trainees rated the videotapes of their own performance in small groups. Some of the scales used were:

Low _____ High
10 20 30 40 50 60 70 80 90 100

Percentage teacher talk
(High rating indicates teacher centeredness)

Rarely _____ Often
1 2 3 4 5 6 7 8 9 10

Teacher use of approval and censure
(High rating indicates teacher centeredness)

Low _____ High
1 2 3 4 5 6 7 8 9 10

Frequency of student comments initiated without teacher recognition
(High rating indicates student conteredness)

Rarely _____ Often
1 2 3 4 5 6 7 8 9 10

Frequency of student-to-student interactions
(High rating indicates student centeredness)

These scales, and a number of others, were always related to observable behaviors. Reasonably high interrater agreement in scoring was estimated. The supervisor and the pupils used during microteaching also completed these scales. The trainee, then, had input from his self-rating, his supervisor rating, and four or five student ratings. It was found that the scales did in fact produce different ratings in conjunction with the style of group process work the trainee had adopted. The verbal report of the trainees was that they did get the "feel" of what different styles could produce. Nothing but these reports exists to document the use of this training procedure. It does appear, however, that with written explanations, a well-produced model tape, and a supervised microteaching practice session, a novice teacher can acquire valuable understanding of the relationships between certain observable behaviors and certain leadership styles in the small-group teaching situation.

Discussion

The skill training approach, utilizing microteaching and the video technology, appears to have born fruit. It has been the experience at the Stanford Secondary Teacher Education Program to hear that the interns who were placed in schools throughout the San Francisco Bay Area, and who had participated in this kind of training, were well prepared to enter the classroom. Thus, anecdotal reports from the field, which are statements about validity and transfer, have been very positive.

The experimentation reported in this review supports a number of statements about teacher training. Some of these statements are based on anecdotal reports, like the reports of the interns' school supervisory personnel, mentioned above. Interns themselves report on their feelings of self-confidence, their ability to handle a classroom, to get along with students, to organize and present material to be learned, and to interact with children in a "real" way. With few exceptions, the intern teachers have felt that microteaching and skill training have benefitted them in these areas. Other anecdotal reports have come from visitors to the program, who have remarked about the high level of competence displayed by the intern teachers.

On the basis of empirical studies, one observation which has import for training technology in general can be reported. In the study of reinforcement reported above, the videotapes from which frequency of reinforcement was rated were obtained in the actual classrooms of the subjects. The playback of the tapes, in which supervisor provided reinforcement for the interns' use of reinforcement, was sometimes delayed many days. Analysis of the data showed no significant differences in skill acquisition, regardless of the time dimension. Thus it appeared that the time lapse was not a critical factor. This finding is contrary to most generalizations about the relationship of time delay and feedback for the modification of behavior. Most studies of animal and human learning have agreed that immediacy of feedback is a prerequisite for effective behavior change. Thus the data obtained on acquisition of the skill of reinforcement, together with other experimentation which was consistent (McDonald & Allen, 1967), indicate that, contrary to existing opinion, immediacy of feedback is not crucial to the acquisition of some behavior:

> The explanation for this may be that the videopape playback reinstates the trainee's performance for him. The whole experience of viewing oneself on the videotape is quite different from receiving information from a second person about one's performance. The character of the feedback experience has changed drastically. Whatever factors might be involved in this new experience are sufficiently different so that the factor of immediacy is no longer relevant (McDonald & Allen, 1967, p. 153).

Though the above observation is contrary to data in the field of human learning, another general finding is quite consistent with the results reported by other researchers. That finding is, simply, that a feedback system in which a trainee views his own performance, with supervision, is an extremely effective technique for modifying some complex teaching behaviors. Investigation of the skill of reinforcement showed that when an experimenter reinforces demonstrations of the skill that is being acquired, and also provides discrimination of that skill when modeling is used, effective training conditions have been created. That fact was confirmed in the study of probing in that the

greatest beneficial effect on acquisition occurred when the experimenter or supervisor was present during the modeling and playback sequence of training. The study of questioning by Claus (1968), refining the earlier work, suggests that the crucial impact of supervision, which emphasizes reinforcement and discrimination, is during the viewing of a model performance. All the studies indicated that the video playback of a teacher's performance is an effective feedback device and, when combined with supervisory aid, becomes even more effective. When model tapes are used in conjunction with video playback, the supervisory role becomes even more important:

> We think that this fact is important to the theoretical development and understanding of observational learning. In earlier experimentation the dependent variable, such as agressive behavior, may have been so dramatic or so sharply contrasted with other ongoing social behavior, that the observer had no difficulty detecting this behavior. However, trainees observing a complex verbal interchange or a complex set of ideas between a teacher and his students, may not easily or readily detect the specific form of the teacher's behavior which was occurring consistently. For example, a probing question may take many different forms, even though its general characteristics and timing remain the same. With an experimenter present to point this out, the trainee quickly learns what behavior to look for and what salient charteristics to identify (McDonald & Allen, 1967, p. 156).

Although it is probable that using videotaped models with the kinds of supervision mentioned in no way detracts from the acquisition of specific skills, it may be unnecessarily expensive. Findings about the effectiveness of perceptual modeling are inconsistent. The development of a model tape and the use of the video equipment are an expensive part of training. Evidence exists that for some skills, probably those most easily described, it would suffice to have symbolic (written) descriptions of the skill. Until a clearer classification of skills is in hand showing which skills require perceptual modeling and which do not, it is probably sensible to incur the extra expense of video models for developing a sound training program.

It appears from the study of higher-order questioning that for acquisition of a skill, the careful matching of the model performance is a useful training device. It appears also that when the model performance presents positive instances of a skill, rather then mixed positive

and negative instances, the ability of the trainee to demonstrate his acquisition of the skill in a transfer task is enhanced. It should be noted however, that conclusions about matching the model and the nature of the model's performance are based upon a single study of a single skill. Hence, generalization across skills is premature.

Also, it seems fair to conclude that teaching can be analyzed and described behaviorally. The significance of this conclusion should not be underestimated. It suggests an approach to both the science and the art of teaching. There appear to be many clearly describable teaching skills which cut across subject matter areas, and which can be developed through training so that almost all teachers can master them and include them in their repertoire. Other less general teaching skills pertaining only to instruction in mathematics or English or science can also be behaviorally described. Certainly, specific model performances demonstrating skills in micro environments can be developed for the teaching of quadratic equations or the teaching of Ohm's Law. Thus, the skill approach is rich in implications for both preservice and inservice teacher education programs in both specific subject-matter areas and general teaching behavior.

Related Research and Development

The potential of a skill training approach within the context of microteaching seems to have been recognized quite rapidly. For example, this writer provided instruction in the philosophy of skill training and the opportunity to view demonstrations of certain model performances for the Cloquet, Minnesota, School District. The personnel there were able to develop an extensive inservice skill training program (Heieie, 1968). Unit credit was given for the teachers to participate in the program; such participation could be used in lieu of university credits toward salary increases. Teachers in subject areas developed videotaped models and practiced in microteaching sessions the skills they thought were important. Although no formal evaluation was made of the training procedure, it was reported that the program created a sense of pride in being a master teacher (i.e., a model for a particular skill). This and the

program's general Hawthorne effect contributed greatly to the functioning of the school. This inservice program has been under the direction of the high school guidance personnel who have relevant training in psychology.

Microcounseling

The Cloquet School District has even expanded the skill approach in teaching to a skill approach in counseling. Models for certain counseling techniques were identified, videotaped, and played back for other personnel involved in the counseling program. Microcounseling, conceptually parallel to microteaching was then conducted. Practice of the counseling skills provided what was thought to be effective training, though systematic evaluation has not been attempted.

Counselor training program. Other people have also been quick to use skill training techniques in the development of microcounseling. Ivey et al. (1968) has described a counselor training program based upon microcounseling techniques which were developed under a Kettering foundation research grant. Three studies were performed in technical skill areas of considerable importance to counseling:

Skill 1 - Responding to feeling: The trainee is taught not to avoid feelings, but to respond to them openly. Among the written examples a trainee receives during instruction is the following excerpt:

> Client: So I'm wondering if you can help me to find a new major. (Pause) I suppose if I did find one, I'd just bungle things again. . .
>
> Counselor: (1) Are you sure that it is necessary to leave the major you are now in?
>
> (2) You feel that it is pretty futile to try again.
>
> (3) What majors have you been considering?

Replies by the counselor that are appropriate in this kind of training should be like response 2, which demonstrates the skill of responding to feeling. Responses 1 and 3 seek additional information from the client without acknowledging the client's feelings.

Skill 2 - Summarizing feeling: In addition to responding to feeling, the trainee must demonstrate his ability to summarize, in his own words, the feelings expressed by the client. This periodic summarization of feelings and perceptions is designed to communicate to the client that the counselor is with him--that he can accurately sense the world as the client perceives and feels it.

Skill 3 - Attending behavior: This skill is described behaviorally, pointing out counselor behavior that shows the client that the counselor is a good listener. Each of the components of counselor attentiveness is described and practiced in microcounseling sessions. It was demonstrated that certain technical skills of counseling were describable in behavioral terms. By using videotaped feedback and model tapes, counselor trainees could acquire important counseling skills.

Minicourses

Based upon the work of the Stanford Secondary Teacher Education Program and the Stanford Center for Research and Development in Teaching, the Far West Regional Laboratory, Berkeley, California, has developed a series of inservice training programs called minicourses. An adaptation of microteaching and the technical skill approach, these minicourses are devised using a 27-step development procedure, including three field tests, and then distributed to participating school districts (Langer, 1969). The materials developed by the laboratory include instructional and model videotapes, teacher handbooks, self-rating forms, and detailed instructions on how teachers can improve their own skills in specific areas through the use of the materials without need for supervision. Minicourse No. 3, titled Effective Questioning in a High School Class Discussion, involves one practice session and ten microteaching sessions to master the skills involved. A statement of the objectives and behavioral specifications required for each lesson are provided the trainee:

Practice Lesson - Objectives: To acquire familiarity with minicourse procedures. To distribute participation evenly.

Specific Behavior: Call on nonvolunteers as well as volunteers.

Lesson One - Objectives: To reduce teacher actions that interfere with class discussion.

Specific Behavior: Repeating own questions.
Answering own questions.
Repeating student questions.

Lesson Two - Objectives: To probe for more thoughtful responses from students.

Specific Behavior: Prompting.
Seeking further clarification.

Lessons Three, Four, and Five - Objectives: To increase teachers' use of higher cognitive questions.

Specific Behavior: Frame comprehension, analysis, and evaluation questions. Use prompting, further clarification, and redirection.

Data obtained by Borg (1969) from field studies in which the course materials were used reveal consistent long-term effects of the skill training. Table 12 presents some of the results.

Table 12

Selected Variables from Data Presented by Borg (1969)

Behavior	Mean Score Before Minicourse	Mean Score Immediately After Minicourse	Mean Score Four Months After Minicourse
Proportion of teacher talk	53.18	29.44	30.44
Proportion of higher cognitive questions	26.16	52.27	48.58
Length of pupil responses (number of words)	5.70	11.55	12.46
Redirection questions	24.71	39.18	36.94

All differences between pre- and postcourse performance were significant. Furthermore, no significant reduction in training effect was

noted between performance at the end of the minicourse and performance four months later. Though all variables in the original report do not show effects as impressive as those reproduced here, the data consistently and strongly support the proposition that the skill training is generally successful and in most cases is retained over time. Moreover, a decrease in teacher talk of over 20 percent and a doubling of the proportion of higher cognitive questions represent effects of clear practical value.

Also of note are the microteaching materials published by General Learning Corporation under the authorship of Allen, Ryan, Bush, and Cooper (1969). These materials were developed for both inservice or preservice populations. Films, videotapes, booklets, and supervisory instructions are combined to form a multimedia package. Models demonstrate skills that are related to broad areas of questioning, increasing student participation, creating student involvement, and presentation of learning material. More detailed descriptions of these skills can also be found in Allen and Ryan (1969).

Particular questioning skills include:

(1) Fluency in asking questions; the goal is to ask as many questions as possible during the lesson.

(2) Divergent questioning; the teacher is to ask questions requiring students to make hypotheses and reorganize concepts into novel patterns.

(3) Probing.

(4) Higher-order questioning.

Skills designed to aid the teacher in fostering and maintaining student participation include:

(1) Cueing students; the goal is to stimulate a reticent student's responding by preparing him to answer certain questions before they are asked.

(2) Recognizing attending behavior; the goal is the trainee's recognition of cues indicating boredom or attentiveness.

(3) Reinforcement.

(4) Use of silence and nonverbal cues.

Another category developed by these authors is called creating student involvement. The skills related to involvement are:

(1) Set induction; the goal is to open a lesson with interesting initiating activities or by using novel frames of reference.

(2) Stimulus variation.

(3) Achieving closure, the complementary skill to set induction, by which teacher activities designed to help students hold a logical organization of the main ideas presented in the lesson.

A final category used in these materials is called presentation skills and includes:

(1) Lecturing techniques which are considered excellent.

(2) Use of inductive and deductive examples in lecturing and varying the rate and complexity of the examples.

(3) Use of analogies and metaphors, the goal being to relate new material to material that has previously been mastered.

(4) Planned repetition. This skill is derived from the work of Young (1967), who used repetition techniques to describe material from different points of view, direct attention to important concepts, and highlight important points. Young described four types of repetition; simple, spaced, cumulative, and massed. Each form of repetition can be described in terms of observable behavior and its probable impact on a learner.

As the technical skill approach to teacher training has expanded, along with the accompanying technology of microteaching, the movement from research to practice has been quite rapid. The "50-year lag" between research and practice often decried in education does not pertain to this innovation. Both advantages and disadvantages accrue as a result of this rapid dissemination. From all available evidence, the skill approach and its use in microteaching appears to be a useful model for both preservice and inservice training. It is important that schools and private industry take rapid advantage of these ideas. Concerns about this rapid dissemination arise from the fact that the original Stanford work was basically a research program, which included many pilot studies that were

actually at a preresearch stage of development. As such, the program is unfinished. The defining of skills, their integration into more general teaching strategies, the development of appropriate training procedures, the learning effects associated with use of these skills, and many other questions of importance have yet to be pursued completely. The final section of this paper outlines the need for research in certain critical areas, and some assumptions upon which the training programs have been based will be examined.

Research Needs

First among many important research areas is the need for creative exploration of the validity of the skills that have been identified. The measurement of pre- and posttreatment differences in teaching behavior, even when those changes appear lasting and reliable, in no way indicates whether or not teacher behavior is affecting students. It is not known if increased use of reinforcement techniques by a teacher promotes student participation or achievement, or is causally related to the development of positive attitudes toward school or the subject matter, or is damaging in some way to the learner. Is varying the stimulus situation beneficial for some or all students because it maintains a high attention level or is it beneficial for some or all teachers because it requires a dynamic presentation style, or is there no effect on teachers or students attributable to stimulus variation?

Every skill identified should include with its description a statement about its effectiveness represented by multivariate criteria. Many different achievement, attitudinal, and behavior domains should be checked to understand the nature of teaching skills with regard to student outcome. Knowing also that students react differently to the same treatments, these should be a search for interactions between learner characteristics and teacher behavior (Cronbach & Snow, 1969) in order to refine and limit validity generalizations that can be made. These data can sometimes be obtained in microteaching or other laboratory environments. The oral behavior, achievement scores, and attitudes of students who participate in microteaching sessions represent data of critical importance. Collection of such data should be an integral part of microteaching studies which incorporate technical skills training.

If a number of skills could be validated through such a research program, proving them reliable in the sense that teacher performances from one microteaching session to another were highly correlated, investigators still need to examine the nature of transfer. It is a commonplace to note that sometimes a child behaves admirably in one household and virtually destroys another. Situational cues which, through training, may elicit desired teacher behavior in microteaching may not be present in real school settings and transfer of the training may not occur. Through concern for reducing the complexity of the classroom and the length of a lesson by using microteaching situations for the development of certain technical skills, a situation yielding little transfer effect to the classroom may have been produced. A concentrated effort should be made to determine the magnitude of transfer from artificial micro environments to real macro environments. Furthermore, since skills are defined in terms of behavior observable in the natural environment, teacher use of particular skills can be measured and related to student behavior in school settings. Without this kind of information it is not known if training teachers in specific teaching skills is an acedemic exercise or a program having genuine impact on education.

Another aspect of the transfer question relates to the combination of technical skills within some of the training programs being developed. Differences in training effectiveness may result from different sequences of skill presentation and practice. Does positive transfer occur from one skill to another, reducing the need for extensive training on subsequent skills? Or are there proactive or retroactive inhibition effects necessitating different training sequences for some or all trainees? Programmatic research efforts should include this kind of investigation of skill interaction or transfer relations among skills.

Another evident need concerns the development of systematic procedures for the identification of new skills. The initial technical skills were drawn from events noted in a somewhat haphazard examination of secondary classrooms. Ideas for skills which survived intense discussions by the project staff were developed into skill studies. Now,

after demonstrating the fruitfulness of the technical skills approach, more systematic methods of skill identification, perhaps using the task analysis techniques developed by human factor psychologists and engineers, are required. Perhaps as behavioral objectives become more and more a part of a teacher's plan of instruction, specific skill approaches for teaching specific objectives will be suggested, developed, and evaluated by teachers themselves.

Finally, a major concern for research in the technical skill approach to teacher training is the integration of skills into more general teaching strategies, planning, and decision-making activities. Currently, there is no way to guide the trainee as to the appropriateness of skills in particular situations. For example, how much verbal reinforcement and under what conditions could cause a student to habituate to the reinforcement technique, so that further use of such reinforcement would have no effect, or perhaps even prompt a negative reaction? The program has succeeded in building the trainees' repertoire of skills. But trainees have been told that the art of teaching consists of technical skills and professional decisions (Bush, 1965). The latter are the basis for determining when, where, and how much to use particular skills. Under the rubric of professional decisions, trainees have been provided only with homilies. Although it was appropriate at the start of the research program to leave these more complex questions aside, they must now be considered for systematic investigation by empirical means. It should be possible to provide guidelines to determine the number, kind, and rate of higher-order questions optimum for students of a particular aptitude in a particular content area. It should be possible to predict, within limits, the rate of habituation of particular students to certain stimulus variation techniques. Eventually, research should provide a set of parameters upon which professional decisions can be based. The artistic and intuitive aspects of teaching and learning should also become more clearly understood as a strong data base is built around questions about what teaching techniques, and in what quantity, can be used under certain conditions with different types of students.

The above discussion has dealt with some major questions about this approach and its assumptions concerning issues of validity, transfer, interaction among skills, skill identification procedures, and appropriateness criteria. Another set of questions relates to research on variables in the training programs. Guidelines for the improvement of those training programs may be developed if attention is paid to the question of:

a. The type of model. As noted above there are no clear decision rules for choosing among videotaped, transcripted, or live models, or even for the use of modeling procedures for particular skills.

b. The teach-reteach cycle. The number of practice teaching sessions is determined by the best guess of the experimenter, in light of the particular skill to be acquired. The use of three trials within a training study has become a norm, but perhaps trials to criterion would be a more appropriate and individualized training procedure.

c. The length of the teaching lesson. Usually about five minutes is allocated for a microteaching session. Though the five-minute length has been defended by Orme (1966), a full rationale based on data should be developed for optimal choice of lengths for particular skills.

d. The number of students in a microteaching lesson. Typically four or five students have been used in a microteaching lesson. Reliance on this particular number is unwarranted. The number of students for a microteaching lesson should be decided by using information concerning student and teacher aptitudes and the nature of the particular skill being trained.

e. The time between teaching sessions. All training studies have utilized what can best be described as a massed-practice format, but much literature suggests that distributed practice usually results in better acquisition of a behavior and more resistance to extinction. One problem is how to decide whether a particular procedure represents massing or distributing of practice. Is 15 minutes between teaching sessions massed practice? Should there be only one teaching trial a day? These are questions which can be studied empirically to produce more effective training programs.

f. The delay between teaching sessions and feedback. The unusual finding that delay of feedback does not seem to result in any weakening of the training has been pointed out previously. The limits of this finding, as judged by the effectiveness of training along a time-delay continuum, need to be studied.

g. Feedback relationships. At Stanford, videotaped feedback for teacher training has been advocated, but it is not yet known if this feedback should occur on every teaching trial where microteaching is used. Live supervision has also been advocated, and consistent evidence gathered about supervisory effects during videotaped feedback. However, Borg and his colleagues have done well without live supervision of the trainees while feedback occurs. Does the more extensive and clear presentation Borg uses overcome the trainee's need for a live supervisor, or do the practicing professionals in an inservice training program need less supervision than the novice teachers used in Stanford's work?

h. The number of skills practiced at a given training session. A question must be raised about whether some or all teachers can master more than one skill per training session. Multiple skill training should be attempted. This question and the question on appropriate sequencing of skills are related. Answers to both would improve training programs.

i. The review procedures. Some evidence was cited above on the long-term retention of some skills. However, little is known about the long-term retention of most skills. Evidence about the longevity of skill training effects should be combined with work which examines the use of review training at various intervals. Some form of retraining procedures may be necessary to keep skills at a high level.

The partial specification of research needed in the area of technical skills and microteaching is a reminder that training procedures must be subject to revision based on accumulating evidence. Initial studies in any area set precedents. In the case of microteaching and technical skills those precedents (choice of skills, number of teaching sessions, number of students in a microteaching lesson, etc.) were often based on administrative convenience, availability of subjects and research

workers, guesswork, and other such considerations. Training procedures should be included in a training program only after it has been demonstrated that they enhance the acquisition of a skill. It should not be necessary to note to people interested in these techniques that dissemination does not preclude research. Much of the needed information about validity, transfer, training techniques, etc., can be obtained or extended while the microteaching and technical skills approach to teaching is being used within the educational community.

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